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REPORT ON VISITS TO RUBBER FACTORIES AND RUBBER TESTING STATIONS IN EUROPE.

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The following report is based on observations made by the writer during visits paid to various rubber factories while on leave in England during 1912 and 1913.

Four of the principal factories and one smaller factory in England and one of the largest factories on the continent, in which all kinds of vulcanised rubber goods were manufactured, in addition to one cable factory in England, were visited.

The Dutch Rubber Testing Station at Delft, Holland, and the Royal Prussian Testing Station at Grosse-Lichterfelde near Berlin were also visited. I was able to spend two or three weeks at the former place and two or three days in the latter and acquire a good general idea of the methods of testing vulcanised rubber goods, and the value of such work.

This combination of visits to factories and testing stations also demonstrated the value of mechanical and other tests on rubber goods, since it was found that the testing machines in use at the testing stations, especially at Berlin, where they are very varied, were also used in the experimental and testing departments of the principal factories visited. The general impression that the various processes used in the manufacture of rubber goods are governed by "rule of thumb" methods was also shewn to be no longer tenable, since, in the larger factories, the processes in the works are frequently, if not always, controlled by experimental work in the laboratory.

As it is impossible for obvious reasons to describe the specific methods adopted in any one factory, general conclusions will be given, based on the methods employed in the factories visited and derived from conversations with Directors, Managers or Factory chemists engaged in the manufacture of vulcanised goods.

Many of the remarks and observations in this report have been published before and may possibly be considered as platitudes. The fact however that such remarks are still made and by manufacturers themselves, is sufficient proof that these observations need emphasizing and will bear repetition.

I propose for the sake of simplicity to deal with the problems involved, under different sections, as follows :—

(1). Cleanliness of raw rubber.
(2). Packing.
(3). Uniformity and Standardisation.
(4). Colour of raw rubber in its relation to vulcanised materials.
(5). Drying. Vacuum and air drying.
(6). Effect of light and heat.
(7). Preliminary treatment of raw rubber in the vulcanising factory.
(8). Plantation rubber and cable manufacture.
(9). Mechanical testing of rubber.
(10). Conclusions.

Cleanliness of Raw Rubber.

A common complaint made by manufacturers was to the effect that a lot of the plantation rubber received in England and elsewhere contained small particles of wood or even sand, or small splinters of wood and this necessitated complete re-washing, involving not only extra labour but probably deterioration of the rubber by the further working on the rollers.

In some instances, samples shown to me, were obviously "bark scrap" in which numerous particles of bark, etc. are still embedded, and the manufacturers did not in some cases appear to realize the origin of this rubber and the reason why such particles were still in the rubber, since they were able to remove them in their own washing machines.

It would appear that a more satisfactory method of treating this class of raw rubber might be adopted on estates, as, in washing bark and scrap and ground rubber in the usual crepeing machines used on estates in this country, much of the finer particles of bark, sand, etc, is tenaciously retained by the rubber.

In the vulcanising factory this rubber is cut up and churned in large tanks of water (usually cold water) by means of paddles. The machine used for the purpose is known as a Hollander. In this way, all the heavy particles (sand, etc.) sink to the bottom of the tank, and the lighter particles of wood float to the surface of

the water. The rubber is then removed by means of large forks and passed through washing machines. This preliminary treatment in large tanks of water is obviously much more effective than washing directly on crepeing machines, as in the latter case, the particles are actually incorporated with the rubber to a considerable extent.

I do not think this tank treatment would be successful with bark scrap as a first treatment—since there is more bark than rubber actually present in the parings and no separation would be effected. The bark shavings would require preliminary conversion to crepe with subsequent tank treatment. A washing machine similar to the Werner-Pfleiderer Universal Washing Machine—in which the washing and machining is carried on under water, should be quite effective for treating this class of crude material.

The manufacturer, knowing that plantation rubber is a washed product, and being able to buy grades which are sufficiently pure to require no rewashing in his factory, naturally expects all plantation qualities to be of such a standard that no further washing or drying is necessary in his factory.

The presence of actual splinters of wood in the rubber is obviously due to the method of packing and will be dealt with under that section.

To manufacturers and those, who, like the writer have had an opportunity of not only seeing the complete process of mixing, calendering and curing carried out in factories but have also carried out these operations themselves, this factor of cleanliness is of supreme importance.

Every particle of dirt, or foreign substance, fabric, etc. in the vulcanised material is a flaw and acts as the weakest point of the material.

In vulcanising experiments carried out by the writer at the Government Rubber Testing Station at Delft, Holland, in the case of one sample, owing to inexperience in calendering, the canvas on which the rubber was calendered, was torn, and small particles of the fabric became incorporated in the mixing and were inadvertently left in the mixing after recalendering and curing; when these samples were subsequently subjected to mechanical tests they ruptured invariably at the flaw and the rupture was quite characteristic in each case.

A similar break also took place at a point in one mixing, where a small quantity of the mixing ingredients had not been properly incorporated with the rubber.

In the continental factory visited, it was found that almost all the plantation crepe and sheet was re-washed in Hollanders and re-creped and dried, before being used for vulcanising purposes.

Packing of Rubber.

The subject of packing is also one which merits further attention and to which reference was made by manufacturers.

As stated by Mr. Wray in his report on the recent Rubber Exhibition in New York, numerous complaints have been made, on account of splinters of wood, etc., in the rubber from the packing cases, and the impossibility of removing rubber from the cases, without breaking up the cases, owing to the shape and size and packing of the contents.

At present there is no relation between (a) the width of the rolls on the washing machines (b) the width or length of the coagulating troughs or pans and (c) the dimensions of the packing case.

The width of the rubber produced in the rolls is a matter for adjustment in quite a simple way, namely the use of guides on the rollers, which may be fixed at any desired distance apart. Such adjustable guides are found on the mixing rollers and calenders in the vulcanising factories, for obtaining sheet of a definite width. The use of such guides would also prevent the oil from the roller bearing from coming into contact with the rubber—as only the most central parts of the rollers can be used. With reference to the size of the coagulating troughs, my opinion is, that the present small enamelled pans are unsatisfactory and involve an unnecessary amount of labour.

Latex should be coagulated in bulk and run into long coagulating troughs, divided off by means of movable partitions. Such troughs can be made quite satisfactorily from a wood which yields no coloured extract with water and these should prove more economical than enamelled or earthen-ware troughs. Periodic disinfection and scrubbing would destroy any bacterial or fungoid growths.

In constructing such troughs, it should be remembered that the sheets of rubber after passing through the washing rollers become somewhat longer and broader and due allowance should be made for this increase, which can easily be ascertained by a few experiments.

Such troughs can then be made, so that the resulting sheet of rubber bears a simple relation to the size of the packing case, *e.g.* one quarter or one half the size.

Packing cases should be made only of perfectly smooth wood to avoid getting splinters or particles of wood in the rubber, since these cause considerable trouble to the manufacturer and may necessitate rewashing of the rubber.

Uniformity and Standardisation.

The first object which it would seem desirable to attain, as far as plantation rubber is concerned, is uniformity. Manufacturers are continually complaining, some bitterly, that they are unable to

rely on plantation rubber on account of this lack of uniformity. It is preferable to have rubber of uniform quality, even it does not attain to the standard of Fine Hard Para, which is the ne plus ultra of the trade, rather than a small quantity of a high grade material which may be frequently varying in quality. In the writer's opinion however. both uniformity and a high standard can be attained at one and the same time—but this means the adoption of definite methods of coagulation, washing, drying, etc. on all estates, whereas at present each individual estate has its own particular method.

Managers however, are unfortunately frequently unable to do this, as demands for particular grades, pale thin crepe, blanket crepe, pale amber crepe, unsmoked sheet, smoked sheet, etc., etc., are often asked for by the Directors of a particular Company from home.

For example, it is generally recognised that smoked sheet of the highest quality, as prepared by one or two well known estates in this country, is equal in all respects to Fine Hard Para and can be used as a substitute for the latter in nearly, if not all the highest qualities of vulcanised goods.

If this be so,—there is no reason why 90 per cent. or more of the estates in this country should not, with care, be able to place an equally good rubber on the market.

There is, as I have stated elsewhere, a certain demand for very pale crepe, for which no other grades can be substituted, and this grade having made a market for itself, will always be required for the specific purposes mentioned, but it has no inherent qualities which would make it suitable for mechanical goods.

The demand can always be supplied by treating the latex with bisulphite of soda, as is being done at present, since this reagent has no deleterious effect on the rubber (if excessive quantities are used the rubber takes a long time to dry).

It must be understood that there is a certain amount of variation even in different samples of Fine Hard Para—but this variation is very slight and not at all comparable to the variations which occur among plantation rubbers. This is due, in the writer's opinion, to the fact that the Amazonian smoking method does not admit of such variation as do the methods of coagulation and machining on estates.

Colour of Raw Rubber in its Relation to Vulcanised Goods.

It is now generally recognised that colour itself has no significance and does not indicate the vulcanising capacity of the rubber. As I have stated elsewhere, however, it may be an indication of the care taken in preparation, or the method of coagulation.

So little attention is paid to this question of colour by many manufacturers, except for one specific branch of the industry, that all the various grades and colours of plantation rubber are, as I have stated in another section, mixed together before vulcanising, in order to obtain a uniform sample.

The question of colour, as far as the planter is concerned, is not always a problem capable of solution by ordinary methods of coagulation, as the latex from different trees varies considerably in colour owing to the rapid oxidation of certain substances present in the exudation from the tree, due to causes at present unknown (Vide Bulletin 17, Department of Agriculture).

For one particular branch of the rubber manufacturing industry namely, dipped goods—in which the final vulcanised article has to be of a light transparent colour, it is essential to use only the palest brands of plantation rubber—pale crepe being usually employed for the purpose.

In the preparation of these articles, the moulds are dipped into solutions of the rubber in solvent naphtha or other solvent till the requisite thickness is obtained and the articles are subsequently "cold cured." A familiar example of these goods is the "Allenbury teat" used on infants' feeding bottles.

Such light coloured articles were unknown before the advent of pale plantation rubber—as it is not possible to wash out the colour from smoked Fine Hard Para, Congo rubber and other sorts. This brand of raw rubber has thus created its own market.

Drying.

The method of drying appears to be the subject of differences of opinion on the part of manufacturers equally with planters.

Some manufacturers, in conversation with the writer, stated that vacuum drying was only resorted to, if a special order was received, which required immediate execution; otherwise the rubber was dried entirely in drying rooms similar in many respects to those in this country, except that these rooms are permanent brick constructions.

In one of the largest factories in England on the other hand, vacuum driers are used entirely and stated to be quite satisfactory. This factory, at any rate, manufactures a large number of high class materials.

The temperature in the vacuum driers appears to be fairly high, one factory using a temperature of 140° F. to 160° F. with a vacuum of about one fifteenth of an atmosphere.

The drying rooms call for special remarks because they embody several principles which the writer considers might be adopted on

estates, and to which reference has been made previously in Bulletin 17 of the Department of Agriculture.

These special features are (a) Artificial heating (b) Circulation of air, (c) Division of drying room into compartments.

(a) *Artificial Heating. The system of* artificial heating consists of a series of steam pipes arranged as a grid which serve to dry the air in the rooms and at the same time to raise the temperature of the drying rooms. The steam pipes are connected with an outside boiler. (Note :—Such a system has recently been installed in a new drying room at the Department of Agriculture, Kuala Lumpur, a description of which will be published in a subsequent monthly Bulletin.)

In a conversation with Mr. Robert Bridge, Managing Director of the rubber machinery firm of Messrs. David Bridge and Company Castleton, England, the writer was informed that that firm has recently sent appliances of this nature to various estates in the Dutch East Indies.

It should be quite simple to regulate the temperature of the drying room as desired ; the cost of raising the steam should be more than compensated for, by the rapidity of drying, allowing the rubber to be shipped more quickly and reducing the size of the drying room required.

Another advantage of rapid drying would be the reduction of possible " spotting " of raw rubber caused by various fungi and bacteria (Vide Bulletins 15 and 17, Department of Agriculture) which are only able to increase in the presence of a sufficient supply of moisture.

(b). *Air circulation.* This is obviously a corollary of the method of artificial heating in order to avoid uneven or excessive heating of the rubber in different parts of the drying room and to remove the moisture laden air. A very small exhaust or force fan is sufficient for the purpose.

The presence of stagnant moisture-laden air in many drying rooms on estates in this country is evidently one reason why " spotting " has occurred to such an extent.

(c). *Division of drying room.* In the vulcanising factories in England and elsewhere, a number of the drying rooms are divided into separate compartments, each provided with its own exhaust.

The reason for this lies in the quality, grade or species of rubber to be dried. High grade raw rubbers, such as Fine Hard Para, best plantation para and other kinds can be dried at a much higher temperature, without deterioration, than inferior and highly resinous rubbers ; some inferior rubbers are unable to withstand even a temperature slightly above that of the atmosphere in Europe, (there will

of course be seasonal differences which may allow of a certain amount of artificial heating).

Each grade of rubber, as far as possible, is treated in these separate compartments at the most suitable temparature.

The advantage of such a scheme on estates, would be to separate the wet samples from the drier ones; each compartment, for instance, might be constructed sufficiently large to hold four or five days yield, the number of compartments corresponding to the total yield of the estate and the period of drying. This can easily be ascertained and the extra cost should not be great.

There is one point to be considered however when comparing the drying of freshly coagulated rubber on an estate and the crude rubbers which are received at the vulcanising factories, namely, the fact that the former contains moisture distributed throughout the sheet, whereas the latter contains principally surface moisture. This does not however affect the value of the principle of artificial drying.

It has been suggested that any method of artificial heating of drying rooms would possibly cause the surface of the rubber to dry first and form an impervious envelope, thus preventing the moisture from the interior escaping so readily; this has however been found not to be so, as raw rubber allows water vapour to diffuse quite readily.

By allowing freshly coagulated sheet or crepe rubber to hang for a day, before placing in the actual drying room, much of the surface moisture is removed, which is a considerable advantage if the drying room is not divided up into compartments as described above. Although raw rubber does not absorb moisture to any extent, the rate of drying is subsequently retarded considerably, by placing very wet rubber in the same room, owing to the increase of the moisture in the room.

Effect of Light and Heat.

The action of light and heat on raw rubbers are problems connected principally with the drying rooms and the latter has been discussed to some extent under a preceding section.

I observed in most of the drying rooms in England, that yellow or red glass windows or blinds were used to prevent the entrance of actinic rays, which are considered to have a very deteriorating effect on raw rubber.

Interesting experiments were also being carried on in the experimental department of the large factory visited on the continent on the action of light on rubber, a powerful mercury lamp being used as the source of light, since this can be controlled and any heat waves intercepted.

If such precautions are necessary in this latitude, they are more essential in this country where the sun's rays are much more intensive and direct.

The question of excessive natural heat in the drying rooms, etc. in Europe rarely arises and the problem is one of artificial heating for drying purposes. As has been stated in a preceding section, the temperature of the drying room depends on the grade or species of rubber under treatment and drying rooms are divided into compartments, in order to deal with each rubber separately.

An interesting experiment which would appear to prove that deterioration caused by excessive rolling in the washing machines is due to the heat set up by friction, rather than to the mechanical strains, was seen at the Dutch Government Testing Station, Delft. The viscosity of a solution of rubber at known concentrations was ascertained; a portion of the sample was then subjected to mechanical treatment on rollers and the viscosity of a solution of this portion was found to be considerably less; another portion was taken and subjected to mechanical treatment in a grinding mill in the presence of liquid air, in order to keep the temperature low; the rubber after treatment was allowed to return to ordinary atmospheric temperature, and a solution was made and tested as before. The viscosity of this solution of similar concentrations was exactly identical with that of the rubber before treatment.

The effect of heat on raw rubber is readily observed on the hot mixing rollers. At one particular point, depending on the temperature of the rollers, the rubber seems to change entirely and becomes peculiarly transparent, resembling seaweed. In this state it can be easily moulded to any shape and has only a very low resiliency. The viscosity of solutions after such treatment is very low.

Preliminary Treatment of Raw Rubber.

Particular attention was paid to the preliminary treatment to which the various brands of raw rubber were subjected after reaching the factory, as, subsequent to this preliminary treatment, the mixing, calendering, cold or hot curing is very similar for all rubbers, (the temperature of mixing and calendering, *i.e.* the temperature of the rollers, is regulated according to the quality of the raw rubber used and the nature of the mixing; as a general rule, it may be stated that Fine Hard Para can be heated to a higher temperature on the rolls than other grades, followed by high grades of plantation smoked sheet, while inferior grades of wild and plantation rubbers are subjected to much lower temperatures. In the manufacture of some vulcanised goods two or more kinds of raw rubber may be mixed together.)

In the case of first quality plantation crepe, no further preliminary washing should be required and the rubber may be only rehung to evaporate any excessive moisture which it may have absorbed during transport. (See section 5 on "drying.")

Unfortunately however this is rarely the case, owing to lack of uniformity in the samples. On account of the variety of grades of all colours, thicknesses, etc., which the manufacturer receives, nearly all plantation rubber is rewashed and mixed together in large batches in order to obtain uniform samples. (*N.B.* I am not assuming here, that colour or thickness, per se, is any criterion of quality but they are indications of different methods of treatment in the estate factory.)

The manufacturer cannot go the expense of testing every sample of plantation rubber which he receives, to ascertain its vulcanising capacity, and he prefers to mix the various qualities together. This both involves extra labour and probably further deterioration of the rubber, but is perhaps less expensive to the manufacturer than testing each separate small batch.

Plantation unsmoked sheet is usually rewashed and creped and in some cases mixed with the various grades of plantation crepe. As a rule it retains too much moisture (a maximum of 0.2 per cent is required) to be used directly.

All grades of smoked rubber, whether Fine Hard Para, smoked plantation sheet or crepe and all inferior, resinous and odoriferous raw rubbers must be washed and creped in order to destroy the odour, dirt, etc., and to reduce the colour to some extent. The final form of all these various grades of raw rubber before vulcanising is therefore thin crepe.

In washing plantation crepe it is cut up and treated with cold water in a Hollander as described in section I.

Fine Hard Para, other grades of Hard Para and lump and ball rubbers are cut up by hand with a large knife and soaked in boiling or hot water in steam heated vats, till they are sufficiently soft for treatment in the macerating machines.

The period of heating and the temperature of the hot bath depends on the species or grade of rubber under treatment. Fine Hard Para is able to withstand more drastic treatment than other sorts.

The macerating machines through which the lumps and balls of rubber are subsequently passed are very similar to the crepeing machines used on estates for washing freshly coagulated rubber, except that the machines are much heavier and the rollers of the machines for the first treatment of the softened lumps are much more deeply corrugated than any crepeing machines in this country.

The final treatment is carried out on large crepeing machines, such as are used in estate factories.

The "loss on washing" of the various grades is obtained after this treatment—being only 1 or 2 per cent in the case of plantation rubber and varying for other grades according to the purity and dryness of the sample.

One problem in connection with the rewashing and machining remains to be solved, viz: whether this treatment of the matured rubber has the same deteriorating effect as prolonged treatment of freshly coagulated rubber on crepeing machines in estate factories. This can be ascertained by preparing smoked and unsmoked sheet rubber (which has been rolled only slightly) and subsequently crepeing the sheet after it has been allowed to hang in the drying rooms for varying periods. This experiment will be carried out later at the Department.

Plantation Rubber and Cable Manufacture.

A visit was paid to only one cable factory, in which the work was entirely devoted to the manufacture of cables, including submarine cables.

This visit, however, was very instructive, as, in the building up of the cable, pure raw rubber is used as the inner core surrounding the metal cable itself and the preparation of this rubber is one of the most interesting features of this manufacture. (As I propose in a subsequent bulletin to write short accounts of various branches of rubber manufacture—a detailed description will be omitted here.)

Another feature, which illustrates the precautions which must be adopted to preserve the life of the rubber and to prevent rapid deterioration, is the coating of the inner copper cable with tin, in order to prevent direct contact between the raw rubber and the copper (See bulletin 17, Department of Agriculture "Action of copper salts on raw rubber").

The managing director, who was also the owner of this factory, which is one of the oldest established cable factories in England and which carries out much work for the Admiralty and the Colonies, in the construction and laying of submarine cables, informed me that he dared not employ plantation rubber at present in lieu of Fine Hard Para on account of its possible short life.

In cable work, as would be expected, the life of the cable is the most important factor and this may be a matter of 20 to 30 years or perhaps more. The fact of a slightly higher cost of the raw material is of little significance when compared with the lasting properties of the rubber of which the cable is constructed.

It is not necessarily suggested in these remarks, that plantation rubber will deteriorate more rapidly (especially in the case of smoked sheet), but the cable manufacturer dare not risk the sub-

stitution, and prolonged experimentation will be necessary before plantation rubber can be safely substituted.

Experiments to test these factors would have to be carried on under sea water and in various solutions of salts.

Various experiments were being carried on in this particular factory in large tanks, but none, as far as I could ascertain with plantation rubber. The managing director informed me that he had found plantation crepe unsatisfactory, but had carried out no experiments with smoked plantation sheet, which I suggested he might find to be very satisfactory.

On the continent, standard testing methods have, I believe, been arranged among cable manufacturers.

In the manufacture of submarine cables, many manufacturers use gutta percha in lieu of rubber, as it is said to be less porous on vulcanising, and the factory visited was apparently one of the few employing rubber for this work.

This manufacturer also complained of the power of the dealers or buyers and of the methods of sampling. I was shown, in this factory, various samples of plantation and other rubbers and was suprised at the sampling ; each sample frequently contained six or more quite distinct grades of sheet or crepe.

An important test in cable manufacture is obviously the insulation test. A current of very high tension is used for such purposes. At the Dutch Rubber Testing Station at Delft, Holland, the writer saw electrical tests carried out on gutta percha sheets, with a current of 100,000 Volts.

Mechanical Testing of Vulcanised Rubber.

More attention was paid to this subject in connection with my visits to factories and testing stations, than to any other problem, in view of the installation of a vulcanising plant at the Department. Much valuable information was derived not only at the Dutch Government Testing Station at Delft and the Royal Prussian Testing Station at Berlin, but also at one or two of the principal factories visited and I was agreeably surprised to find in these factories that much attention and care is devoted to the problem, especially since one has been led to believe generally that factory operations are guided only by "rule of thumb" methods.

The universal testing machine used by testing stations and by consulting rubber chemists and factories is the Schopper machine made by the firm of Louis Schopper & Co., Leipzig.

These machines are made in all sizes, for the testing of single threads and fibres, papers, yarns and cloths, belting and mechanical rubber goods. Although the machine is rather expensive, it is constructed in a very excellent manner and is of great precision.

A large number of other machines for abrasion tests, stretching tests, impression tests, etc., are also employed and the Royal Prussian Testing Station is exceedingly well equipped in this respect. A fuller description of these machines will be published later in the monthly bulletin.

I am convinced, after my visits to these factories and testing Stations, of the value and importance of this work and hope to be able to instal a number of these machines at the Department when the vulcanising machinery is erected.

Conclusions.

As these visits were arranged in order to ascertain manufacturers' requirements and opinions as to the value of plantation para rubber, methods used in vulcanising factories, standardisation, uniformity, forms of rubber which were considered desirable, ideas as to the value of testing rubber goods, and the methods of testing, I consider that much valuable information has been derived, which will be of great assistance when the vulcanising plant is installed at the Department and they have also convinced me as to the desirability of such an installation.

The rubber dealer appears, at the present moment, to control the market and is probably not at all anxious to see the development of this idea of testing or guarantees for raw plantation rubbers, since it must, in time, affect his position, if estates, by means of guarantees, are able to deal more directly with the manufacturer.

It will probably take some years to develop and to make the buyer realise the value of such guarantees, but a Department of Agriculture, in an important rubber producing country such as the Federated Malay States, should, in my opinion, embark on such a scheme, without waiting for suggestions of this kind to come from the manufacturers; its object should be to educate and influence the buyer in this respect. Apart from the question of standards, guarantees and so forth, such a vulcanising and testing department should be able to give the planter valuable information as to the value of the rubber he is preparing by any particular methods, and suggest improvements where necessary. In every industry, scientific methods are being more fully developed and found to be of great value, and with a valuable product such as rubber, such methods are even more essential than in many other industries.

I wish to express my deep thanks to the Managing Directors, Managers and Chemists of the factories visited, who in every instance gave me every facility in connection with my visits and enquiries. My deepest thanks are also due to Prof. J. Van Iterson, Chairman of the Committee of the Dutch Government

Rubber Testing Station, Delft University, Mr. F. G. Fol, Chemical Engineer and Officer in charge of the Station, who personally assisted and advised me in the experiments carried on in Delft, Prof. Dr. Martens, Director, Prof. Dr. Hinrichsen and Prof. Memmler of the Royal Prussian Testing Station, Grosse-Lichterelde Berlin, for permission to visit and inspect the rubber and other testing departments and for advice, Dr. Frank and Dr. Marckwald, consulting rubber chemists to the Colonial Department of the German Government and Dr. Schridowitz, consulting Rubber Chemist, etc,, of London and to Messrs. Schimmel & Co: for permission to visit their Essential Oil Works at Miltitz bei Leipzig.

My thanks are also due to the German and the Dutch Governments for granting me permission through the British Colonial and Foreign Offices to visit the above government institutions.

THE RUBBER INDUSTRY IN SUMATRA.

The following notes condensed from the Report of the Akers Commission are taken from the *India Rubber Journal* of March 29:—

The Commissioners visited the principal rubber growing districts of Sumatra. These lie on the east coast of the island, and include the districts of Langkat, Deli, Serdang, Padang, Batœ Bahra, Asahan and Bila. A few estates have been opened in other sections of the country, but difficulties of transport have prevented any extensive cultivation outside the districts mentioned. Roads and railways are in course of construction, or projected, to link up the existing cultivated areas and to give access to forest lands hitherto lying idle, but some years must elapse before these projects materialise, for the Dutch Colonial Government is slow to move in such matters and requires very substantial proof of the necessity and financial value of such undertakings before becoming in any way responsible for them. It is for this reason that the rubber planting industry has been practically confined in the past to the districts where coffee and tobacco estates were established many years ago and transport already existed, or to certain sections along the Bila River where communication by water is available.

Area of Rubber Estates.

Statistics regarding the extent of cultivated rubber in Sumatra vary considerably, and no official return is made of the acreage or number of trees. A handbook published in Medan places the area at 126,000 acres in 1911, but qualifies this by stating that details of many plantations are omitted. A census furnished by the Neder-

landsche Handel Maatschappij gives the number of trees in 1911 as 16,733,470, or approximately 167,000 acres.

The Secretary of the Planters' Association of Sumatra informed me that the returns in 1911, on which subscriptions were based, showed about 145,000 acres under cultivation, but that these did not include isolated estates on the west coast or any Chinese or Malayan holdings. In the circumstances I consider the returns of the Nederlandsche Handel Maatschappij much the most reliable on account of the facilities appertaining to that very important corporation for acquiring accurate information, and, therefore, I accept the estimate of 160,000 acres as being a conservative calculation of the area under cultivation in December, 1911. So far as my inquiries go the additional acreage ready for planting during the present year (1912) is not less than 60,000 acres, of which 55,000 lies in the districts on the east coast and 5,000 on the south-eastern and western sections of the island. Many planters assure me that this figure of 60,000 acres for 1912 is too low, but I cannot obtain confirmation of any greater area.

The following table shows the expansion of the rubber planting industry during the past seven years:—

Year.	Area under cultivation.	Increase.
	Acres	Acres.
1906 ...	6,140 ...	—
1907 ...	20,150 ...	14,010
1908 ...	38,800 ...	19,650
1909 ...	67,000 ...	28,200
1910 ...	100,000 ...	33,000
1911 ...	160,000 ...	60,000
1912 ...	220,000 ...	60,000

The Ficus trees, of which 351,000 were planted previous to 1909, are not included in the above figures as they are being cut out on the majority of the estates. The holdings of Malays and of Chinese settlers are numerous, but of very limited extent, and in the aggregate are only a small proportion of the total acreage.

During the last three years the tendency has been to open larger plantations than formerly, a notable case in point being the Holland-American Company at Asahan where 13,000 acres have been planted in the last two years, and further extensions are now being made to bring the total area under cultivation to 30,000 acres.

Possibilities of Expansion.

The amount of land available for the extension of rubber planting in Sumatra must be counted by millions of acres, for two-thirds of the island remain untouched to-day. But other considerations besides suitable land must play a most important part in the future

development of the industry. The question of the labour supply enters largely into the problem, and although at present no complaint is heard of any scarcity on the estates, the demand will be substantially increased as the existing young plantations reach the tapping stage. Then, again, means of communication require great additions and improvements before the necessary foreign capital will be attracted for the extension of the industry to the forest lands of the interior. It is more probable that expansion in the near future will take place along the banks of navigable rivers or in the localities hitherto reserved for growing tobacco. It is in this latter direction that a rapid development is possible. For many years Deli has been the centre of the tobacco industry, and to the east and west an area of some 400,000 acres has been devoted to tobacco cultivation. After one, or at most two, crops has been gathered, the land is allowed to lie fallow for seven years before being replanted, and so 400,000 acres in reality means 50,000 acres of cultivation. In the present circumstances the inclination to plant rubber trees after the tobacco crop is harvested is a tempting proposition. Practically no expense is involved beyond keeping the land clean to allow the trees to come to maturity. If any substantial drop in the value of tobacco occurs there is small doubt that a very considerable portion of these tobacco lands will be converted into rubber estates.

Tenure of Land.

Land is held in Sumatra under long leases from the native sultans, these concessions being approved by the Dutch Colonial authorities. As a rule the terms of holding are not less than fifty and not exceeding one hundred years. The rental varies, but is generally at the rate of one guilder (20 pence sterling) for each bouw, equal to one and three-quarters English acres. These land grants comprised a large acreage when they were obtained for tobacco growing on account of the necessity of fallowing the land for seven years before replanting, and this has resulted in the alienation of practically all the land on the east coast of Sumatra lying between the seaboard and the foothills of the mountain ranges from the Lankat districts on the west to Asahan on the east.

Taxation.

No direct taxation is imposed on the rubber industry, and to assist the planters the Colonial Government some time ago promised that no export duty should be levied on the raw material in the immediate future. It is the general opinion, however, that this condition will be revised before many years have elapsed and an export duty collected. The general revenue of the colony is derived from

a 12 per cent. duty on all imported merchandise, a 4 per cent. income tax, and from various municipal and local taxes.

Catch Crops.

On the majority of the older estates in Sumatra the rubber has been grown amongst other crops, and many of the young plantations are now planted with robusta coffee as a catch crop. There is not the smallest doubt that the Para trees planted amongst Liberian coffee have suffered severely as regards their development, and in some isolated cases this damage is permanent. For the first two years the shade of the Liberian coffee shuts out light and air from the young trees and the result is everywhere seen in the uneven growth—plantation of 5 and 6 years old often not tapping more than 50 per cent. of the trees. Another catch crop equally harmful is rice, which is frequently grown. It only stands to reason that a crop yielding 1,200 pounds of grain and a large amount of straw must be harmful to a plantation of young trees. Tobacco has been tried as a catch crop, but is universally condemned. Robusta coffee apparently is the only product which can be grown in conjunction with Para rubber without serious prejudicial effect, so far as I can judge. It certainly retards the growth to some extent, but the rubber trees are not shut out from air and sun; and this coffee gives amazing returns of 15 and 20 cwt. to the acre when the bushes are from 2 to 2½ years of age. At the present time this coffee is selling at 70 shillings per cwt., and at this price the temptation is certainly very great to harvest two or three crops before cutting it out from between the lines of the rubber trees. This is especially so when old coffee machinery exists on an estate and can be used for preparing the robusta coffee for the market.

Management of Estates.

The expansion of the rubber industry in Sumatra is of such recent date that there are not very many experienced planters in the country. Naturally the ranks have been recruited from the coffee and tobacco planters, and these men, accustomed to plantation work, are rapidly learning rubber cultivation. The majority of the managers and assistants are of Dutch or Swiss nationality. A few Englishmen are scattered through the country, but the number is extremely limited. The demand for both managers and assistants in the Malay Peninsula has been so great during the last few years that few men from there have cared to take up plantation work in Sumatra under the Dutch flag, and so it happens that although many estates in Sumatra are owned by British companies, and more than half the capital invested is of British origin, the work is superintended by Dutch or Swiss representatives, with few excep-

tions. Probably the fact that salaries are 40 per cent. lower in Sumatra partly accounts for this state of affairs. The system of plantation management and accounts in vogue in Ceylon and Malaya is gradually being introduced on all rubber estates, and will become generally established in the course of the next few years.

Discipline on Estates.

The standard of discipline varies on different plantations. On some estates visited no complaints were made by the managers, but on others the reverse was the case, and much bitter sentiment was expressed in connection with the attitude of the Colonial Government. The pith of the matter is that the planters are strictly forbidden to punish their labourers, and the authorities will take no effective steps to do so. This condition was confirmed to me by quite independent and reliable persons, such as the managers of the Nederlandsche Handel Maatschappij, and several agents and merchants in Medan and elsewhere. In the Bila district during 1911 one English and two Swiss managers were murdered by estate labourers. Inquiries failed to show any reasonable provocation for the acts. Apparently the managers were dissatisfied with the work of certain coolies, and insisted that the men should do their duty in better fashion. Disputes followed in each case, and the coolies attacked the managers with hoes and knives and killed them. I saw one of the murderers in the gaol at Tandjong, Balei, where he was serving a term of four years' hard labour for his crime. The other men received similar sentences.

Cost of Production in 1911.

Owing to the method of keeping estate accounts in Sumatra it is no easy matter to arrive at exact figures in regard to the cost of production of a pound of rubber f.o.b. port of shipment.

After very careful inquiry I consider the average cost of production f.o.b. Sumatra for 1912 and 1913 should be as follows:—

	Cents.	
1. Tapping and collecting	29	Includes depreciation on cups and implements.
2. Curing	5	Includes depreciation on factory and machinery.
3. Transport	1	
4. Commission and shipping charges	1	
5. Weeding	3	
6. Cultivation	2	
7. Management	7	

8.	Depreciation	3	On buildings other than factory.
9.	Hospital	2	Share of central hospital with other estates.
10.	Maintenance of roads and drains	2	
11.	Rent	1	
12	Contingencies	2	
	Total ...	58	

This is equal to 11½ pence sterling. As the trees become older and the growth in the former coffee plantations less uneven the cost should show a substantial decrease, and the ultimate minimum cost should not exceed 50 cents, or 10 pence sterling per pound of rubber f.o.b. Sumatra.

Analysis of Expenditure.

An analysis of the foregoing cost of production shows that 70 per cent. is for labour charges. Therefore any increase or decrease in this cost principally depends on the wage rate of coolies and efficient supervision to ensure economy of labour whenever possible. Management and labour combined sum up 47 cents out of a total cost of 57 for each pound of rubber produced. The lower cost as compared to Malaya is due to the smaller intrinsic value of the monetary unit.

Charges from port of Shipment to Date of Sale.

The charges from port of shipment in Sumatra to London, Liverpool, Antwerp, or Amsterdam are the same as those ruling from the Malay Peninsula. Freight from Medan and other ports on the east coast is fixed at 75 shillings per 50 cubic feet. Quite recently an additional charge of 2s. 6d. has been added on account of the coal strike in the United Kingdom. For the purpose of this report commissions are calculated on a selling value of 4s. 2d. per pound, and consequently would rise or fall with any fluctuation in prices. The custom in Sumatra is to pack the rubber in boxes containing 112 pounds, running 10 boxes approximately to the 50 cubic feet. The charges are :—

		Pence per lb.
1.	Freight	.83
2.	Rebate to buyers 2½ per cent. draft ...	1.50
3.	Brokerage	.25
4.	Bale charges, insurance, storage and sundries	.75
5.	Merchants' commission	.50
	Total	3.83

Estimate of Total Average Cost Per Pound of Rubber to be sold in London or Liverpool in 1912.

With the average cost f.o.b. Sumatra of 11½ pence per lb. of rubber, the total cost up to date of sale in London or Liverpool will be 11½ pence plus 3.83 pence, making 15.33 pence per lb. during 1912. If a fall in the value of rubber to 2s. should occur, the total cost up to date of sale would be 14.21 pence per pound. As there is every reason to suppose that the ultimate minimum cost of production f.o.b. Sumatra will not exceed 50 cents, or 10 pence, the total cost with rubber at 4s. 2d. would be 13 83 per pound, or with the market value at 2s., 12.71 pence per pound..

Past and Future Production.

In Sumatra at present it is useless to apply normal yields to the acreage under cultivation in order to ascertain probable immediate production, for the reason that until 1909 nearly all the rubber trees were interplanted with Liberian coffee, their development choked, and their needs neglected in every way. It is only in the last two years that attention has really been given to the rubber trees and the coffee cleared away to allow them a chance to recover from past ill treatment. Trees that should now be yielding 3 lb. of rubber at 6 and 7 years of age are giving little more than one-third of that amount. That these trees have survived at all is a matter for surprise, and that they are rapidly regaining normal conditions tend to show their amazing vitality.

Elevation Above Sea-Level.

The majority of the rubber estates are situated at elevations of from four feet above sea level to a height of not more than 120 feet at the foothills of the mountain ranges. The former elevation covers the flat lands near the banks of navigable rivers, such as the Bila, and certain sections of the tobacco districts, the latter those of the undulating country stretching up to the mountains. A few plantations have opened at higher elevations, but the area is insufficient at present to form an important factor in the situation. The trees are in a thriving condition at these higher altitudes, even up to 1,000 feet above sea level.

Soil.

There are three distinct varieties of soil in the rubber districts of Sumatra:—

(1) A black, friable topsoil mixed with sand and lying on a strong clay subsoil, forming the low-lying lands adjoining the larger rivers. (2) A black, friable topsoil mixed with sand on a subsoil of clay and sand and chiefly found in the tobacco districts. (3) A

friable chocolate topsoil on a hard laterite subsoil, these characteristic features extending over the undulating lands reaching to the foothills of the mountain ranges. In numbers 1 and 2 the water is near the surface, extensive drainage is necessary, and the root growth of the tree is lateral, the tap-root not penetrating below the water level. On the laterite soils the tap-root penetrates to great depth, frequently as much below ground as the height of the tree is above the surface. I met with no intelligent appreciation amongst planters of this radical difference of root growth, or any attempt to take it into consideration when laying out estates. Trees are planted at the same distance apart on high lands where a deep tap-root develops and on low lands where the tap-root disappears, and its place is taken by abnormal lateral growth. The trees develop rapidly on both low and high lands, but on the former they are specially liable to serious damage from the severe storms which constantly occur on the East Coast of Sumatra, and at times these reach hurricane force.

NOTES ON INSECTS PESTS.

By C. B. Holman-Hunt.

The principal Insect that has attracted almost universal attention this month has been the Locust which has been seen in swarms in many districts in Selangor and Negri Sembilan. Fungus cultures have been tried on it with but little success. A fair number of Malays, Tamils and Chinese have availed themselves of the liberal Government reward of 50 cts. per kerosine oil tin full and some have made quite a nice little addition to their regular earnings by catching even the "fliers" when asleep. The damage done has been very trivial to date and not at all like the devastation described as the result of the visit of Locusts in South Africa, the Locusts here however seem to have very few natural enemies and they are very prolific and it is to be hoped that all the Penghulus will do what they can to turn out Malays to earn the reward. The Locusts have not up to the present attacked Rubber, and it is very unlikely that they will ever do much damage to it, but they do feed on Coconuts and Padi and it is advisable, without being scared, to keep their numbers in check as much as can reasonably be done without incurring the enormous expenditure that would be necessitated in a wholesale campaign against them even in the hopping stage. They would certainly find many suitable breeding grounds far from cultivated areas, where they would not be discovered and the only scheme that promises well is the inoculation of a number of "fliers" with some form of fungus; I have found a local grass-

hopper affected with a fungus in the open but was unable to obtain a successful culture. It will be very helpful if any planter or insect collector will send in any insects that he finds with a fungus growth on it, especially if it is one of the grasshoppers.

ORNAMENTAL CLIMBING PLANTS.

By J. Lambourne.

(*continued*)

Beaumontia grandiflora, an Apocynaceous quick-growing, woody climber, native of India, is an attractive plant and a useful addition to every garden on account of its large corymbs of white flowers which are borne in the axils of the leaves, and at the tips of the young branches. The flowers are large, the corolla being campanulate in shape, the limb spreading and five lobed white and the tube being short greenish at the base, and dark in the throat. This species can be grown quite easily from cuttings.

Combretum grandiflorum, native of Sierra Leone, is a beautiful climbing plant with woody stems, oblong hairy leaves, and large scarlet flowers. The latter are borne in both axilary and terminal spikes.

C. racemosum also a native of the West Coast of Africa differs from the above in its white flowerswhich are borne on short pedicels, in panicles of many spikes. The spikes are elongated and tufted at the apex, and its leaves are ovate oblong, acute and shining. Both species can be propagated from cuttings of well ripened shoots.

Quisqualis indica, the "Rangoon creeper," a common woody climber, native of both Tropical Asia and Africa, is a very beautiful plant and should have a place found for it in every garden where possible. Its fragrant flowers vary in colour from orange to red and are borne in umbels at the tips of the young shoots. This plant can be propagated quite easily from cuttings.

Gelsemium sempervirens, a slender stemed evergreen climber with fragrant flowers disposed on short peduncles in the axils of its thin coriaceous, shining, oblong-lanceolate leaves. The corollas are yellow in colour and indefundibuliform in shape. This plant is very fine for covering arches and trellises if well trained; and it can be propagated from cuttings of well ripened parts of young shoots.

Jasminum sambax, native of India is worth cultivating on account of its white fragrant flowers, which are disposed in small trichotomous cymes, and its cordate evergreen leaves. This plant may be propagated from cuttings of well ripened shoots.

J. auriculatum, also a native of India and Mauritius, is a white flowered climbing shrub. The flowers are fragrant and the corollas seven parted, disposed in small cymes. Propagation as above.

The following are half woody or herbaceous climbers being wood in some cases near the base and in the very old parts of the stem only.

Abrus precatorious is a pretty little Leguminous climber with small, pale purple, butterfly shaped flowers disposed in axilary clusters. The flowers are not the most attractive part of the plant however, as the seeds being bright scarlet with black spots at their bases are very beautiful. The plant is slender stemed and apart from either flowers or seeds is a very graceful little plant. The seeds are used by Buddhists for rosaries and the roots have virtues of the common liquorice. Varieties with white and rose coloured flowers are also met with. The plant can be propagated quite easily from seeds.

Clitoria ternata a very pretty twining Leguminous plant bearing beautiful azure flowers set off by horseshoe shaped rings of pure white. The flowers are borne singly on fairly long pedicels in the axils of the leaves. There are also varieties with blue and white flowers and double forms worthy of a place in the garden. This plant is best propagated from seed.

Ipomoea bonariensis, a beautiful climber native of Buenos Ayres, is a very attractive climber with tuberous roots ; long twining branched, purplish coloured stems on which are borne its palmately cordate three to five lobed leaves and purplish lilac flowers. The flowers are solitary and borne on pedicels in the axils of the leaves.

I. Horsfalleae a native of the West Indies is a delightful free growing climber with quintately digitate leaves and flowers of a deep glossy rose colour disposed in dichotomous cymes in the axils of the leaves. It grows quite freely from cuttings and will reach to a height of from 10 to 12 feet. *I Horsfalleae* var *Briggsi* is very free flowering variety with flowers of a slightly richer colour.

I. Palmata is a very common climber with numerous slender twining and glabrous stems, the older of which are woody and rough with lenticels. The leaves are small, compound, digitately five to seven lobed and the flowers funnel-shaped, dull violet with a purple throat. These flowers are usually solitary or two or three borne on swollen pedicels in the axils of the leaves. This species is common in hedgerows round Kuala Lumpur and makes a good covering for unsightly banks, tree stumps, etc. It can be grown quite easily from cuttings or seeds.

Ipomoea Bona-nox, an annual climber, native of tropical, America, bears its fragrant white flowers in the axils of its leaves, on one to three flowered peduncles. The corolla tube is long and tubular opening only at night when it gives off a very sweet scent. Propagated from seeds.

I. rubro-coerulea is an American climbing plant, attractive on account of its flowers which are white in the bud with limbs of a rich lake colour; these when fully expanded become fine purplish blue in colour. The flowers are borne on three or four flowered peduncles in the axils of the deeply cordate leaves. Also propagated from seed.

Quamoclit phoenicea, Chois. or *Ipomoea coccinea*. Clark, a native of America is a weak, climbing subscandant herb naturalized throughout S. E. Asia and well worth cultivating on account of its dark red or scarlet flowers which are borne in axilary, lax, few flowered cymes. Its leaves are ovate, cordate, acute, entire or slightly lobed and glabrous. This plant is very useful for planting in tubs and training over low trellises. It reproduces itself quite freely from seed.

Q. pinnata, Boj. or *Ipomoea Quamoclit*, Linn., as it has been named is also naturalized here and is a very graceful little twining herb with leaves which are ovate in outline but pinnatoely divided into numerous segments. The dark red tubular flowers borne in axilary lax, few flowered cymes, inter mixed with the foliage makes it an attractive little plant for training on trellises on low wire netting which may require covering. This species may also be propagated from seed.

Jacquemontia violacea is a pretty little climber, native of Mexico and Brazil, with oblong-cordate, acuminate leaves and pale blue flowers disposed in few flowered, axilary umbels. It is very useful for growing in large pots or tubs and training over low trellises. This plant can be propagated quite easily from cuttings.

Momordica Charantia, native of India and Malaya, is a thin stemed Cucurbitaceous climber with palmately five lobed leaves and yellow flowers. The fruits of this plant are the most conspicuous part, being oblong, acuminate, angular, tuberculated, copper coloured to red, and bursting open at the apex into three valves showing the bright red coloured pulp covering the seeds.

M. Cochinchinensis, native of India and Formosa, is also attractive on account of its fruits which are large oval rotundate in shape and red in colour. This species is dioecious *i.e.* bearing its male and female flowers on different plants.

The flowers of the male plant are very large about 4 inches in diameter and borne on long single flowered peduncles; the calyx is deeply cut into five ovate-lanceolate lobes, striated with black; the

corolla is campanulate in shape of five petals which are pale straw colour; the minor petals being dark purple at the base. The female flowers are like the male but are borne on long pedicels. The fruits of both of the above species are edible and both can be grown quite readily from seed.

Passiflora edulis is a Brazilian species with edible fruits and fragrant white flowers tinged with purple. The fruits when ripe are livid purple in colour and elliptic in shape about 1½ inches in diameter. The edible pulp is orange in colour with an acid flavour assembling that of an orange. Its leaves are trilobate, serrated with petioles which are biglandular at the apex.

P. laurifolia the "Jamaica Honeysuckle" or "Water Lemon" also has edible fruits and sweet scented flowers. The leaves are glabrous, ovate, oblong, entire with petioles which are biglandular at the apex and silaceous stipules which are about the same length as the petioles. The fruits are about the size of a hen's egg, but rather more elongated, yellow with white spots containing a whitish pulp which is edible.

P. trifasciata, native of Para, is an evergreen climber with whitish fragrant flowers and trilobate leaves marked down the centre of each lobe by a broad irregular band of reddish purple, the back of the leaf being of a dark sanguineus hue.

There are numerous other species of Passiflora equally beautiful but space will not permit me to mention them all here. They may all be propagated by cutting from well matured young shoots.

Thunbergia grandiflora is a large climber, native of India, bearing its large blue flowers in long racemes. Its leaves are ovate or the uppermost ones lanceolate about 6 inches long, acute cordate at the base, toothed, often angular lobed and pubescent. Its variety "*alba*" is white flowered as its name implies.

T. coccinea, a large Indian climber bearing flowers which are red to orange rose in colour, disposed in long loose pendant racemes, 15 to 18 inches long. Its leaves on the lower parts of the stems are ovate in shape while those on the upper parts are oblong, obtuse and cordate or angular at the base. These two species can be propagated quite easily from cuttings.

T. fragrans is a native of Malaya and quite common by the sides of roads, and in hedgerous in parts of this country. It is a slender stemed retrorsely climbing plant with pure white fragrant flowers disposed in ones or twos on pedicels in the axils of its ovate-oblong, acute or obtusely cordate leaves. This species may be propagated either by seeds or cuttings.

T. alata, a small twining plant, native of South Africa and naturalized in this country, is a pretty little plant with flowers having yellow corollas with purple throats; the tube is slightly

curved and the limb campanulate. The flowers are borne singly on peduncles in the axils of the cordate saggittate leaves. This plant is a canescent annual twiner and can be propagated readily from seed.

Vitis amazonica is a very pretty climber with ornamental foliage. Its leaves are large, oval, acuminate, smooth glaucus red beneath with veins silvery above. The young ones are almost linear with their veins strongly marked. Propagated from cuttings. Other species of *Vitis* worthy of cultivation are *V. discolor*, *V. elegans*, *V. furcata*, *V. glaberrima* and *V. gracilis*, all natives of Malaya except *V. discolor* which is a native of Burmah.

HOW TO DISTINGUISH DIFFERENT ORDERS OF INSECTS IN THEIR VARIOUS STAGES.

Diptera Siphonaptera and Thysanoptera.

By C. B. Holman-Hunt.

The Diptera include the Daddy-long-legs, Mosquitoes, Midges, Fungus-gnats, Horse-flies, Bot-flies, House-flies and many others. Their habits are very various, some feeding in the grub stage on plants, roots and stems, others on decaying animal matter, while others again are parasitic in living animal tissue and even eggs. They may be conveniently divided up according to the length and number of joints of the antennae.

Those with long many-jointed antennae include the Mosquitoes, Gnats and Daddy-long-legs.

Those with one to three-jointed antennae include the Horse-flies, Bee-flies and Robber-flies.

Certain wingless forms are found which include the Bat-tick and Bee-louse.

The Diptera are usually distinguished by the reduction in size of the lower wings, which assume a racquet-shape and are known as Balancers or Halteres, though in some cases as before mentioned the Diptera are wingless and parasitic on mammals, birds and other insects. Some Diptera form galls and one large group feeds in the grub stage on fungi.

Of the Diptera the Culicidae are perhaps of the greatest local interest. They are distinguishable from other Diptera by the scale-like hairs with which the wings are fringed. Scales are also often to be found on the veins.

Most Culicid larvae are aquatic.

The Culicidae may be divided into

i. The Culicines or True Mosquitoes.

ii. The Anophelines or Malaria-carrying Mosquitoes.

The eggs of the Culicines are laid in boat-shaped clusters, the eggs themselves being long, blunt at one end and pointed at the other and slightly curved. The pointed end is uppermost so that a concave raft is formed. Each raft is said to consist of from 200 to 400 eggs.

The eggs of the Anophelines are usually laid singly or in small triangular clusters in water.

The larvae of the Culicines float in stagnant water with their heads downwards and with the long breathing siphon opening on the surface.

The larvae of the Anophelines on the other hand frequent slowly flowing streams and lie parallel to the surface and in their case the siphon is short.

The pupae of the Culicines have the siphon long.

Those of the Anophelines have a short siphon.

In all the Culicidae the pupae are active.

The adult Anopheles can be recognised by the position which it takes up when resting, it stands with the proboscis and body in a straight line and the two at an angle with the surface on which it is standing, while a Culex stands with its proboscis at an angle with the body and the body parallel to the wall or mosquito-net.

The Diptera can be further divided into families according to the arrangement of the veins, but this would be too advanced a study for an elementary article.

Speaking generally the Diptera are of more interest to the Medical man and Veterinary Surgeon than to the Agriculturist and those that are of interest to him are often his best friends.

A wedge-shaped larva may often be found on shoots affected with Aphides, this should be carefully preserved from damage as it kills off the pests in large numbers, and finally emerges as a Syrphid fly possessing a black body with broad yellow transverse bands.

The Siphonaptera may be here mentioned, as they were at one time classed with the apterous Diptera. They include the Fleas, of which the chief interest lies in their recently discovered connection with Plague and other diseases. They undergo a complete metamorphosis, the larva of a flea being a small worm-like grub without legs, it feeds on dust.

The Thysanoptera which include the Thrips, undergo a slight metamorphosis only and have sucking mouth parts. They are often overlooked on account of their small size but are important pests, as they are very prolific and when in numbers weaken the plants of which they suck the juices from the stem and leaves.

SOIL ANALYSES.

Managers desiring analyses made of soils of their estates for the purpose of arranging manurial trials, etc., are requested not to take the samples themselves but to communicate with the Director of Agriculture, who will arrange that the officer in charge of soil work shall visit the estate, take the samples and make the necessary notes on conditions, etc., himself.

DEPARTMENTAL NOTES.

Mr. F. de la Mare Norris, B.Sc. Assistant Agricultural Inspector, Department of Agriculture, F.M.S., arrived at Kuala Lumpur and assumed his duties on April 12th.

Mr. F. W. South, B. A., Mycologist to the Imperial Department of Agriculture for the West Indies, has been appointed Chief Agricultural Inspector, Department of Agriculture, F.M.S.

MINUTES OF KAJANG DISTRICT PLANTERS' ASSOCIATION

GENERAL MEETING.

HELD IN KAJANG CLUB ON THE 14TH MARCH, 1913, AT 4, 15 P.M.

Present. O. P. Dakeyne, K. G. Furley, F. B. Kendall, W. M cole Hamilton, E. N. T. Cummins, E. G. Leyne, S. S. Stevens, F. St. Barbe, D. St. L. Parsons, C. Burn Murdoch (Chair).

GENERAL.

The minutes of the last Meeting was confirmed.

Planters' Association Chairman. The following resolution was proposed by Mr. E. N. T. Cummins and seconded by Mr. O. P. Dakeyne. "In view of his splendid services as chairman of the Planter's Association of Malaya, it is resolved that the thanks of the Kajang District Planters' Association be tendered to Mr. Macfadyen and that he be earnestly requested to stand for the chairmanship of the Planters' Association of Malaya so that a continuity of policy, so ably laid down in the past year, may be secured: in the event of his consenting to stand he is hereby appointed our nominee." Carried unanimously.

Discharge Tickets. The question of discharge tickets was discussed and a resolution proposed by Mr. O. P. Dakeyne and seconded by Mr. D. St. L. Parsons was passed to the effect: "That the system of universal discharge tickets throughout the country receive the support of this Association here and at the meetings."

Rates. The chairman, while agreeing that discharge tickets might help to stop bolters, did, not see that it would prevent coolies giving notice as freely as, if not more freely than, before unless the Planters themselves made up their minds not to raise rates. The figures which had been sent in shewed that many estates were now paying 40 cents for Tamils. As long as planters offer 40 cents it will be expected that coolies receiving 30 to 35 cents will send in their notices. No action of the Government or Planters' Association of Malaya will help us unless we help ourselves.

Pay Day. The chairman pointed out that the law as it now stands, enforcing as it does the payment of wages on the 10th, of each month. is a cause of great inconvenience to the Planters and some loss to the industry. Tamils usually slack off on Sundays and Mahomedans on Fridays. The natural pay days are therefore Saturdays and Thursdays, and by paying on these days the respective slack day becomes the day after pay and causes little inconvenience or loss. In addition to this Saturdays and Thursdays are the days on which the coolies have heretofore been accustomed to be paid. The difference in dates is very small, if we look at the calendar, Saturdays and Thursdays fall on the following dates.

Saturday	Thursday
March 8th	March 6th or 13th
April 12th	10th
May 10th	8th
June 7th	12th
July 12th	10th
Aug. 9th	7th
Sept. 6th, or 13th	9th, or 11th
Oct. 11th	9th
Nov. 8th	6th, or 13th
Dec. 6th, or 13th	11th

He proposed the following resolution which was seconded by Mr. E. N. T. Cummins and unanimously carried :—

"That the Government be asked to allow the date for paying coolies to be in the case of Tamils the Saturday nearest to the 10th of each month and in the case of Mahomedans the Thursday nearest to the 10th of each month."

DISTRICT PLANTERS' ASSOCIATION ULU SELANGOR.

At a Committee meeting of the Ulu Selangor District Planters' Association held at the Rest House, Kuala Kubu on 30/3/13 the following were present :—

Messrs. W. De L. Brooke (Chairman), N. H. Dakeyne, F. S. Lyne, E. Granville Smith and M. D. Fallon (Hon. Sec).

Minutes of the last meeting were read and pased.

The balance sheet for the past year was checked and audited and found correct by Messrs. N. H. Dakeyne and E. Granville Smith.

At a General Meeting held at the Rest House after the above meeting the following were present: Messrs W. De L. Brooke (Chairman), W. A. Henderson, R. M. Newton, L. W. Tivy, F. S. Lyne, F. G. Herose, E. Granville Smith and M. D. Fallon (Hon Sec)

Visitors Messrs. McKilligie and A. G. Peiniger.

1. Minutes of the last meeting were read and confirmed.

2. Reports and accounts for the last year were passed.

3. Proposed by Mr. N. H. Dakeyne. That Government be asked to provide a telephone service in connection with Kuala Lumpur, Kuala Selangor and Ipoh throughout the district.

After some considerable discussion it was decided to get the Hon. Sec. to write to the Posts and Telegraphs department for information as to costs etc. and on receipt of same circularize the district to find out who are prepared to support the scheme.

4. Proposed by Mr. F. S. Lyne, seconded by Mr. W. A. Henderson and carried *nem. con.*

"That Government be asked to print copies of the Estates' returns of locally recruited coolies fortnightly and to distribute these copies to those persons who are willing to subscribe towards the cost of printing. These returns are compiled regularly and the cost of printing copies of same should be infinitesimal and would be covered by a small subscription from each person supplied with the copies."

5. Mr. W. De L. Brooke was again elected Chairman for the ensuing year.

Mr. E. Granville Smith were elected as Hon. Secretary in place of Mr. M. D. Fallon who is going home on leave.

The following was elected as committee for the year:—

Messrs. W. A. Henderson, N. H. Dakeyne R. M. Newton and F. G. Herose.

6. Proposed by Mr. Brooke, seconded by Mr. M. D. Fallon and carried *nem. con:*—

That the subscription for the year be fixed at $15/ with a power by the Committee to raise it another $5 if found necessary.

7. Proposed by Mr. L. W. Tivy, seconded by Mr. M. D. Fallon and carried *nem. con:*—

That the Hon Secretary be ex officio elected as one of the delegates for the P. A. M. for the year.

Mr. Brooke being also elected the two delegates for the year are Messrs. Brooke and Granville Smith.

Before the election of the Chairman Mr. Brooke spoke a few words as to the progress and work done by our association and by the P. A. M. during the last year.

Votes of thanks were passed for the very excellent work done by our Chairman and retiring Hon. Sec.

A vote of thanks was also passed for the work done by the Committee. No other business being brought forward the meeting closed with a vote of thanks to the Chair.

KAJANG DISTRICT PLANTERS' ASSOCIATION.

Annual General Meeting held in Kajang Club at 4.45 p.m. on the 18th, April.

Present. P. F. Wise, K. G. Furley, G. D. F. Sinclair, H. W. Rickeard, C. G. Jeavons, O. P. Dakeyne, D. C. P. Kindersley, F. St. Barbe, E. N. T. Cummins, C. Burn Murdoch (Chairman).

The Chairman gave a short resume of the work done during the year. The Association was formed on the 17th, May, 1912 and was duly affiliated with the P. A. M. There were during the past year three General Meetings, in May and July 1912 and in March 1913.

At the July meeting the matter of telephones at goods stations was brought up and Government approached on the subject; as your Association met with a negative reply the matter was taken to the P. A. M. by one of your delegates and met with warm support. Your delegate Mr. E. N. T. Cummins and the Chairman P. A. M. were appointed by the P. A. M. to see the Chief Secretary on the subject. The matter came up again before the P. A. M. meeting in January at Penang and correspondence with the Government was read. It is to be hoped that at the P. A. M. meeting on the 27th we shall hear that our request has been granted.

Practically all the estates in the district were subscribers to your Association and also paid up their subscriptions.

The district responded well to a call for figures giving the ruling rates of pay. These show that the wages of Tamils are being forced up, which is much to be regretted.

The question of discharge tickets has been discussed and your Association has expressed their wish to support such a measure, and I hope this may help to stop absconders, but I do not think it can be expected to stop coolies giving notice as freely as ever unless Planters make an effort to keep the rates of pay down.

Business.

1. *Minutes of last meeting.* These were read and confirmed, being proposed by Mr. D. C. P. Kindersley and seconded by Mr. K. G. Furley.

2. *Accounts.* The accounts for last year ending 31st March were passed being proposed by Mr. P. F. Wise and seconded by Mr. O. P. Dakeyne. Thanks are due to Mr. Parsons for the audit.

3. *Election of office bearers.* Mr. C. Burn Murdoch was re-elected to the Chair and the following were elected to the committee, Messrs. P. F. Wise, E. N. T. Cummins, G. D. F. Sinclair, D. C. P. Kindersley, E. M. Schwabe. The first three of these and the chairman were appointed delegates to the P. A. M.

4. *Estimates.* The estimates were discussed and it was proposed from the Chair and seconded by Mr. D. C. P. Kindersley, "that the subscription for the current year be 15 dollars." Carried.

5. It was pointed out by the Chairman that as the law now stands (sec. 75 c. of the Labour Code) only authorised officers, the Secretary for Chinese Affairs or the Controller of Labour or a duly authorised person under the section, may sign on Javanese second or subsequent contracts. This causes considerable delay and inconvenience to both the Government officials (two only are now available to go out to estates) and to the planters and coolies who wish to sign on. It is naturally impossible for two officials to go out to estates constantly for one or two contracts to be signed. The following resolution was proposed by the Chairman and seconded by Mr. K. G. Furley and passed. "That the Government be asked to amend section 75 c. of the labour code so as to include the District Officer with those authorised to sign on contracts."

The meeting closed with a vote of thanks to the Chairman for his services in the past year.

NOTES ON THE SINGAPORE MARKET FOR STRAITS PRODUCE DURING APRIL 1913.

Black Pepper.—An improved demand set in towards the latter part of the month, and a steady advance in price took place, business having been done at $19.3/8 to $19.1/2.

White Pepper.—Continues very scarce, and only inferior grades were available for sale. A moderate advance in price has taken place however, and ordinary Sarawak cannot be bought below $34.

Gambier.—Is practically unchanged with perhaps a little less demand than during the previous month. Closing quotations are from $7-20 to $6-75 according to quality.

Cube Gambier.—A moderate business was done in No. 1 at $10.1/4 to $10 5/8, but No. 2 was not wanted and is quoted nominally $9.1/4.

Copra—After a sharp advance has once more declined and closes easy at the following prices:—

Bally	$11-80
Kayong	$11-50
Pulo	$11-40
Siantan	$11-40

Rubber—The market has been very dull. Closing values are:—

Fine Pale Crepe	$170
No. 2 Crepe	$150
Smoked Sheet	$150/171
Unsmoked Sheet	$145/164
Scrap Sheet	$140

Tapioca—Is unchanged with little demand, transactions have been reported at $6.1/4 for Flake and $6-40 for Medium Pearl.

Nutmegs—No business reported, closing quotations are $22 for 110s and $24 for 80s.

Sago Flour—Has declined and business has been done as low as $3-40/3-45 according to quality.

FEDERATED MALAY STATES.

Comparative Statement of Cultivated Rubber Exported, with Value and Duty Collected Thereon, during the Years 1913 and 1912.

Places of Destination.	Exported during Mar., 1913.	Previously.	Total export during the year 1913.	Export during similar period of previous year.	Increase.	Value of rubber, 1913 to date.	Duty collected, 1913 to date.
	Tons.	Tons.	Tons.	Tons.	Tons.	$	$
Straits Settlements ...	781.14	1,537.80	2,318.94	1,384.51	934.43	8,231,725	205,777.27
United Kingdom ...	805.81	1,962.36	2,768.17	2,016.38	751.79	9,871,737	246,793.43
Continent of Europe ...	107.74	255.08	362.82	269.62	93.20	1,293,078	32,326.96
Ceylon	42.64	132.89	175.52	140.16	35.37	629,051	15,726.27
Other Countries ...	...	...	...	...	...	...	...
Total ...	1,737.33	3,888.13	5,625 46	3,810.67	1,814.79	20,025,591	500,623.93

KUALA LUMPUR,
11th April, 1913.

W. J. P. HUME,
Commissioner, Trade and Customs, F.M.S.

Abstract of Meteorological Readings in the various Districts of Malaya for the Month of March, 1913.

DISTRICT.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	TEMPERATURE.				HYGROMETER.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Khota Bahru	...	147.	81.0	86.80	73.64	13.16	77.7	.883	75.5	83.	...	3.19	1.62
Malacca, Durian Daun Hos.	29.887	146.3	81.7	87.6	72.3	15.3	78.	.909	...	84.	N.	2.57	.60
N. Sembilan, Dist. Hospital Seremban	...	145.1	79.0	88.1	70.5	17.6	74.4	.819	72.4	83.	N. W.	7.66	1.34
„ Dist. Hos. K. Pilah	...	158.3	80.1	90.3	70.7	19.6	76.9	.865	74.8	84.	...	6.75	1.34
„ „ Tampin	...	156.7	79.6	85.9	73.2	12.7	75.2	.782	71.8	77.	...	6.08	1.59
„ „ P. Dickson	...	157.1	81.8	88.1	74.6	13.5	77.2	.846	74.2	77.	...	3.86	1.00
Pahang, „ K. Lipis	...	...	79.6	89.2	68.1	21.1	73.8	...	...	...	...	10.03	2.90
Penang, „ Penang	29.799	157.	84.1	97.	73.	24.0	77.1	.831	72.2	72.	...	3.80	1.00
Perak, „ Taiping	...	108	81.70	92.	71.	21.	77.39	.881	...	83.	...	15.44	2.40
„ „ Ipoh	...	...	82.09	93.	71.	22.	76.77	.849	...	78.	...	12.38	2.66
„ „ T. Anson	...	...	82.25	93.	68.	25.	77.71	.889	...	81.	...	8.85	1.78
„ „ P. Buntar	...	...	82.28	90.	72.	18.	77.27	.868	...	79.	...	7.62	2.20
„ The Cottage	...	...	...	...	...	...	...	...	...	...	...	13.13	5.38
Selangor, General Hospital Kuala Lumpur	...	144.6	81.1	89.5	72.5	17 0	76.2	.845	73.5	77.	...	11.69	3.10
„ Dist. Hos. Klang	...	...	...	87.1	64.4	22.7	...	...	...	...	...	7.16	2.55
„ „ K. Selangor	...	...	...	88.4	69.3	19.1	...	...	...	...	...	4.03	1.70
„ „ Rawang	...	...	...	90.2	71.7	18.5	...	...	...	...	...	13.29	3.03
Singapore, Kandang Kerbau Observatory	29.877	158.2	81.8	91.5	71.0	20.5	77.4	.882	...	83.	N. E.	20.80	6.38